Computer Graphics
CMPT 460.3/837.3

University of Saskatchewan

Final Examination (Open Book)

Instructor: *Herbert Yang*
Date: December 19, 1992
Total Marks: 100
Time Allowed: 180 minutes

Answer **all** questions. Read each question carefully and budget your time. The marks do not necessarily reflect the difficulty of the question. Use your judgement. Write neatly and clearly.

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1. (20 marks - 4 marks to each topic)

   Select and discuss five of the following projects presented in the Graphics class. You should emphasize on the interesting features of the projects and not on the details.

   Note: You are not allowed to select your own project.

   (a) Day, Randy, "A command language to control movement of stick figures on a video screen."

   (b) Doell, Perry and Loren Budd, "3-dimensional object rendering tool."

   (c) Thiessen, David, "Reproducing images with fractals."

   (d) Lorrain, Norman, "Implementation of voxels."

   (e) Vu, Ngoc Chu, "Hidden surfaces."

   (f) Abdel-Hamid, Gamal, "Dynamic programming approach for active contour models."

(g) Philip, Tim, "Interactive LaTeX environment."

(h) Oster, Greg, "An implementation of an algorithm for drawing general undirected graphs."

(i) Falk, Joel, "Creating a CAT scan image."

(j) Choy, Raymond, "Class marker."

(k) Zhu, Wanning, "Color quantization of images: implementation and analysis."

(l) Chen, Kerhong, "Plants modeling using L-systems and shadow algorithms."

(m) Ferguson, Lyndsey and Kit Yim, "Light and afterlight."

(n) Chodzicki, Donald, "Rapid re-rendering of ray-traced scenes."

2. (30 marks)

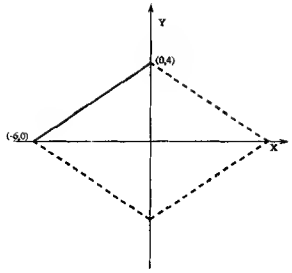
You are to display lines on a monochrome (with only one-bit grey scale, i.e. B/W) monitor. Use the **mid-point** method to derive a double-step line generation algorithm for lines with slope less than 1. The derived double-step algorithm must not need floating point operation and it must be a complete algorithm. You may assume that the line goes through the origin. Terms or variables that you use in the derivation must be defined and explained. *Note: You are not allowed to assume that the pixel can have more than 1 bit of resolution.*

3. (20 marks)

Outline all the steps with appropriate equations (if needed) for ray-tracing an ellipsoid with the following equation:

$$\left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2 + \left(\frac{z}{c}\right)^2 = 1.$$

Define all the terms and variables that you use in your answer. To simplify your discussion, you may assume the ellipsoid is located at the origin as specified by the above equation. With respect to this corrdinate system, the position vector to a pixel on the screen is denoted by S, the center of projection by C and the light source vector by L.



4. (30 marks)

   (a) (10 marks) Derive an incremental line algorithm that will draw a line from (0,4) to (-6,0) (see above figure).

   (b) (20 marks) Apply geometric transformation to derive a program that generate lines indicated in the above figure as the dashed lines. All of the steps must be included in your answer. No marks will be given if you just write the answer.

Have a Merry Christmas and a Successful New Year!